

WHAT IS CLAIMED IS:

1 1. In an application requiring the conduction of heat between an
2 exothermic device and a heat sink surface, the improvement comprising interposing between
3 said exothermic device and said heat sink surface a heat-spreading layer of a composite
4 comprised of carbon nanotubes dispersed in a matrix of ceramic material, said composite
5 having been uniaxially compressed in a direction transverse to said heat sink surface.

1 2. The improvement of claim 1 in which said composite is the product of
2 a process comprising consolidating a mixture of ceramic particles of less than 500 nm in
3 diameter and carbon nanotubes into a continuous mass by uniaxially compressing said
4 mixture while passing a pulsed electric current through said mixture.

1 3. The improvement of claim 1 in which said composite has a density of
2 at least 90% relative to a volume-averaged theoretical density.

1 4. The improvement of claim 1 in which said composite has a density of
2 at least 95% relative to a volume-averaged theoretical density.

1 5. The improvement of claim 1 in which said composite has a density of
2 at least 98% relative to a volume-averaged theoretical density.

1 6. The improvement of claim 1 in which said composite has a density of
2 at least 99% relative to a volume-averaged theoretical density.

1 7. The improvement of claim 1 in which said carbon nanotubes are
2 predominantly single-wall carbon nanotubes.

1 8. The improvement of claim 1 in which said carbon nanotubes constitute
2 from about 1% to about 50% of said composite by volume.

1 9. The improvement of claim 1 in which said carbon nanotubes constitute
2 from about 2.5% to about 25% of said composite by volume.

1 10. The improvement of claim 1 in which said carbon nanotubes constitute
2 from about 5% to about 20% of said composite by volume.

1 11. The improvement of claim 1 in which said ceramic material is a metal
2 oxide selected from the group consisting of alumina, zirconia, magnesium oxide, magnesia
3 spinel, zirconia, titania, cerium oxide, chromium oxide, and hafnium oxide.

1 12. The improvement of claim 1 in which said ceramic material is alumina.

1 13. The improvement of claim 1 in which said ceramic material is alumina
2 and said carbon nanotubes are predominantly single-wall carbon nanotubes constituting from
3 about 5% to about 25% of said composite.

1 14. The improvement of claim 2 in which said process comprises
2 uniaxially compressing said mixture at a pressure of from about 10 MPa to about 200 MPa
3 and a temperature of from about 800°C to about 1,500°C, and said sintering electric current is
4 a pulsed direct current of from about 250 A/cm² to about 10,000 A/cm².

1 15. The improvement of claim 2 in which said process comprises
2 uniaxially compressing said mixture at a pressure of from about 40 MPa to about 100 MPa
3 and a temperature of from about 900°C to about 1,400°C, and said sintering electric current is
4 a pulsed direct current of from about 500 A/cm² to about 5,000 A/cm².

1 16. The improvement of claim 1 in which said exothermic device is a
2 microprocessor.

1 17. A structural component requiring thermal insulation in high-
2 temperature environments, said structural component comprising a substrate coated with a
3 thermal barrier coating of a composite comprising carbon nanotubes dispersed in a matrix of
4 ceramic material, said composite having been uniaxially compressed in a direction transverse
5 to said surface.

1 18. The structural component of claim 17 in which said composite is the
2 product of a process comprising consolidating a mixture of ceramic particles of less than
3 500 nm in diameter and single-wall carbon nanotubes into a continuous mass by compressing
4 said mixture while passing a pulsed electric current through said mixture.

1 19. The structural component of claim 17 in which said composite has a
2 density of at least 95% relative to a volume-averaged theoretical density.

- 1 **20.** The structural component of claim **17** in which said composite has a
2 density of at least 98% relative to a volume-averaged theoretical density.
- 1 **21.** The structural component of claim **17** in which said composite has a
2 density of at least 99% relative to a volume-averaged theoretical density.
- 1 **22.** The structural component of claim **17** in which said carbon nanotubes
2 are predominantly single-wall carbon nanotubes.
- 1 **23.** The structural component of claim **17** in which said carbon nanotubes
2 constitute from about 1% to about 50% of said composite by volume.
- 1 **24.** The structural component of claim **17** in which said carbon nanotubes
2 constitute from about 2.5% to about 25% of said composite by volume.
- 1 **25.** The structural component of claim **17** in which in which said carbon
2 nanotubes constitute from about 5% to about 20% of said composite by volume.
- 1 **26.** The structural component of claim **17** in which said ceramic material is
2 a metal oxide selected from the group consisting of alumina, zirconia, magnesium oxide,
3 magnesia spinel, zirconia, titania, cerium oxide, chromium oxide, and hafnium oxide.
- 1 **27.** The structural component of claim **17** in which said ceramic material is
2 alumina.
- 1 **28.** The structural component of claim **17** in which said ceramic material is
2 alumina and said carbon nanotubes are predominantly single-wall carbon nanotubes
3 constituting from about 5% to about 25% of said composite.
- 1 **29.** The structural component of claim **18** in which said process comprises
2 uniaxially compressing said mixture at a pressure of from about 10 MPa to about 200 MPa
3 and a temperature of from about 800°C to about 1,500°C, and said sintering electric current is
4 a pulsed direct current of from about 250 A/cm² to about 10,000 A/cm².
- 1 **30.** The structural component of claim **18** in which said process comprises
2 uniaxially compressing said mixture at a pressure of from about 40 MPa to about 100 MPa

3 and a temperature of from about 900°C to about 1,400°C, and said sintering electric current is
4 a pulsed direct current of from about 500 A/cm² to about 5,000 A/cm².

1 **31.** The structural component of claim 17 in which said structural
2 component is a combustion gas turbine blade.